Tracking Student Success in Order to Assess the Instructor Effectiveness to Improve Student Retention and Graduation Rates

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Abstract

This paper explores the metric of follow-on student success that can be considered when evaluating an instructor's effectiveness. The metric is the follow-on course success rate which should be useful in engineering since many fundamental courses are prerequisites to follow-on courses. For example, students who pass thermodynamics 1 should be able to pass thermodynamics 2. The data shows that the follow-on success rate depends on the instructor who teaches the first course. As more universities focus on student retention and graduation rates, they should investigate metrics to gauge how well an instructor prepares students for subsequent academic success. This paper looks at course follow-on success rate in a two-semester sequence of thermodynamics courses.

1. Introduction

Some universities are using course failure rates to identify instructors and courses that are impediments to student success. The University of Texas at San Antonio has adopted a maximum goal of 20% failure rate in all courses. The failure rate is computed as the fraction of students who enroll in the class and then either withdraw (W) or earn a D or F final grade. These students need to retake the class in order to progress in the program. When the course failure rate exceeds 20%, then instructors are required to develop and submit plans to reduce the failure rate. The plans are expected to describe how the instructor will change teaching practices, course content, or assessment tools such that more students pass. One obvious consequence of this policy is that instructors pass more students regardless of learning and mastery of the material. There is little initiative to understand causes for high failure rates, such as initial student preparedness for the course, student motivation to succeed in the course, or student learning accomplished at the end of the semester.

The dominant way to assess the effectiveness of an instructor is to poll students near the end of the semester. A typical question is "How do you rate the teaching of this class" and students select 1 through 5 with 1=poor to 5=excellent. The usefulness and potential biases of student surveys has long been questioned yet they continue to be used as an important tool to measure the teaching effectiveness of faculty [1]. Well-designed student evaluations have largely been found to be useful measures of teaching effectiveness and are often the primary measure used at many universities [2]. Instructor survey are often affected by the perceived clarity and organization of the course, the availability and helpfulness of the instructor, the relevance of the material, and feelings that student time as not wasted [3]. Student feedback may not be strongly correlated with actual learning. Other metrics to evaluate teaching performance have been proposed, such as having students assess their learning using the course learning outcomes or student drop rate [4]. The notion of assessing actual student learning in a course is much more difficult, however, the reliance of student perceptions or feelings toward the instructor continues to be used. A recent survey concluded that there is no significant correlation between evaluations and learning [5]. Numerous potential biases exist, especially when some instructors have lenient grading policies, hence higher student grades correlate with higher teacher evaluations [6, 7]. The idea of measuring actual student learning in a course is not new, it is just expensive and elusive. The authors have looked at correlation of two semester thermodynamics course to see if one can identify instructor for the first course better prepares students for success in the second course [8]. Likewise a study looked at student grades in engineering statics with grades in follow-on courses in engineering dynamics, thermodynamics and solid mechanics. These courses have statics as a prerequisite. In evaluation of 860 students taking statics in 24 different classes with 10 different instructors, there was often low numbers to support strong statements about the correlation of grades in statics and then follow-on classes, especially when some instructors teach the course only a few times. At best, data supported the assertion that the best instructors could be identified and the grade-based correlation can explain up to

25% of the future grade success in follow-on courses [9]. This paper is a continuation of previous studies trying to identify metrics to assess the effectiveness of instructors.

2. Evaluation Method

This study evaluates the performance of 3341 students enrolled in the first course in Thermodynamics 1 (thermo1) from Fall 2002 to Spring 2016. There were 52 sections of the thermo1 taught by 11 different instructors. Subsequent progress of students into Thermodynamics 2 (thermo2) during the same time period was tracked. Raw data is shown in table 1 with the number of students taking thermo1 and then the number taking thermo2. If students took thermo2 from the same instructor, then they are excluded from the follow-on thermo2 pass rate analysis. This study only considers the effectiveness of the thermo1 instructor, and an analysis of the data shows a strong follow-up success rate in thermo2 if the same instructor taught both courses. In total, the performance of 1072 students in their first attempt at thermo2 is used to evaluate the effectiveness of the instructors teaching thermo1. Data shows that the first attempt pass rate in thermo2 varied from a low of 64% to a high of 94%. In no cases was the follow-on pass rate 100% in thermo2. The difference between 64% (low) and 94% (high) is considered to be significant. Based on the data, it would suggest that Instructor-9 did a significantly poorer job of preparing students for thermo2 compared to Instructor-3.

Table 1. Tracking of 3341 attempts at thermo1 followed by 1072 first attempts at thermo2.

	N take thermo1	thermo1 %Pass	N take thermo2	thermo2 %Pass, first try
inst-1	148	66%	93	91%
inst-2	248	36%	54	85%
inst-3	277	43%	115	94%
inst-4	234	56%	96	81%
inst-5	168	62%	35	89%
inst-6	930	52%	101	87%
inst-7	53	83%	40	80%
inst-8	798	53%	244	81%
inst-9	178	60%	97	64%
inst-10	38	58%	21	81%
inst-11	269	77%	176	69%
sum or avg %	3341	54%	1072	81%

Figure 1 shows the thermo2 pass rate (y axis) versus the thermo1 pass rate (x axis). The idea is that some instructors have a high pass rate regardless of student learning. Some student then pass thermo1 only to be confronted with the challenge of passing thermo2. In some cases, students complain that the thermo1 instructor was too easy so that they passed without learning, yet were then had to learn both thermo1 and thermo2 in order to pass the second class. Because of the large number of students and instructors evaluated in this paper, the data shows a relatively low R^2 value of 16%. Those instructors with the highest pass rates in thermo1 often had the lowest pass rates in thermo2. When data for three instructors (inst-5, inst-7, and inst-10) are excluded because of the low number of students tracked into thermo2, the R^2 value increases to 27%, but that plot is not included in this paper.

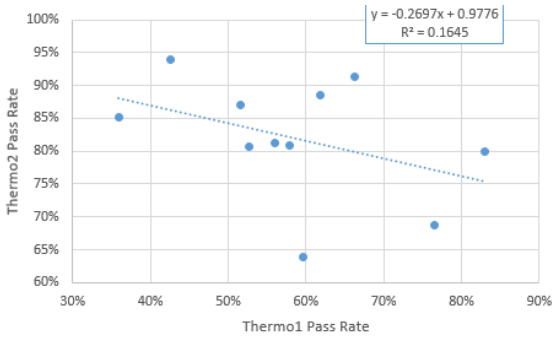

Figure 1. Thermo2 pass rate versus thermo1 pass rate for 11 different instructors over 3341 students from 2002-2016.

Figure 2 plots the thermo2 grade point average (GPA) for the first attempt at thermo2 for the students who passed thermo1. On the x-axis, the thermo1 class GPA is used. In total, there are 52 classes taught by 11 instructors from 2002 to 2016 plotted in Figure 2. The data shows a few outliers where the instructors teaching thermo1 appear to have abnormally high class gpa (near 2.6) while the majority of classes had a gpa near 2.0. The trend is that those classes with high thermo1 gpa tend to have low subsequent thermo2 gpa. Again, this indicates that for some instructors, students were able to pass thermo1 yet were not well prepared for thermo2, hence they had lower gpas than other students who passed thermo1 with other instructors. Although there is a discernable trend, there correlation is relatively low at R^2 = 25%.

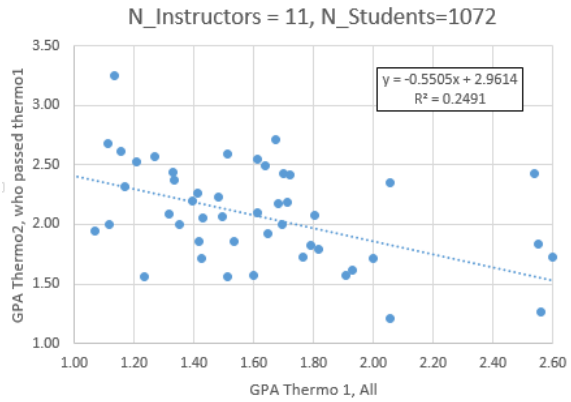

Figure 2. Thermo2 pass rate versus thermo1 class gpa for 52 classes taught by 11 different instructors from 2002-2016.

4. Summary

In summary, the effectiveness of an instructor continues to be difficult to access. It is proposed that the follow-on success rate of students who pass a prerequisite course be used to assess the effectiveness of an instructor. For example, the success of students passing thermo1 and then attempting thermo2 should be studied to assess the effectiveness of the instructor teaching thermo1. In this study, the highest follow-on success rate is about 95%, or only 1 in 20 student first attempts at the follow-on courses was not successful. Instructors with highest follow-on success rates are not identified in this paper but are known to be some of the best instructors in the department. In contrast, some instructors have significantly lower follow-on success rates of about 64%. This is equivalent to saying that 1 in 3 student first attempts at the follow-on courses was not successful. Overall, this is considered extremely high. Some students needed more than 2 attempts at thermos2 before they passed. Overall the correlation on the order of R^2 = 25% are common for these types of data, showing that student initiative and perseverance strongly impact academic success and the effectiveness of instructors teaching prerequisite courses is limited in predicting follow-on student academic success.

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